Module 7

Sediment Budget Analysis System for ArcView (SBAS-A)

Module Overview

1. Introduction: SBAS-A Overview
2. Exercise A: Creating Littoral Cells
3. Exercise B: Creating Flux Layers
4. Exercise C: Determining Values for Cells and Fluxes
5. Exercise D: Calculate Volume Difference per Littoral Cell
6. Exercise E: Entering Values to Cells
7. Exercise F: Entering Values to Fluxes
8. Exercise G: Creating Macro Budgets
9. Exercise H: Saving/Loading SBAS-A Alternatives

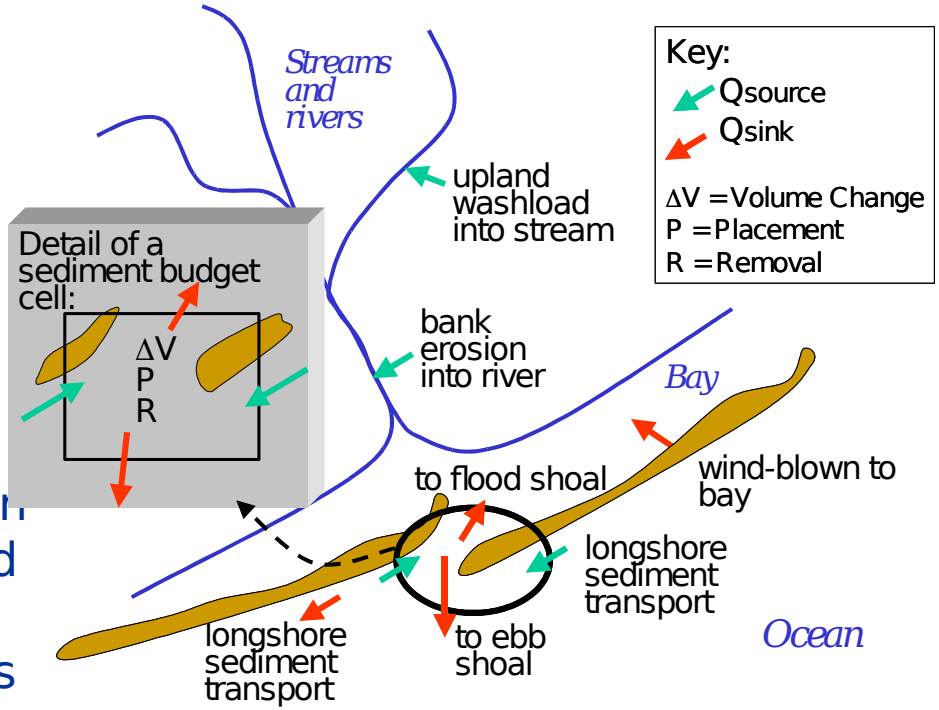
Sediment Budget Purpose

- The importance of a sediment budget lies in the ability to assist in identifying longshore sediment transport rates, sediment patterns and pathways, areas of erosion and accretion, and understanding beach and bathymetry change over the region.
- Regional impacts resulting from modifications to site-specific projects can be identified. Thus, the purpose of the Regional Sediment Management study.

SBAS - OVERVIEW

- The **Sediment Budget Analysis System** (SBAS) provides a framework for formulating, documenting, and calculating sediment budgets, including estimation of uncertainty, hence the reliability of the budget.

- SBAS automatically formulates and substitutes these quantities into the sediment-budget equation based on the origin, terminus, and direction of arrows representing rates. This visual procedure allows an integrated quantitative budget to be formed based on the conceptual budget, which satisfies the macro-budget.



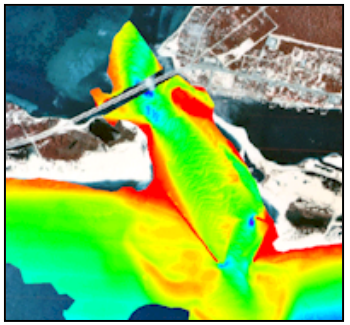
Using SBAS-A

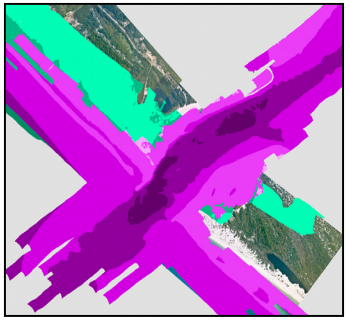
- Establishing a regional sediment budget is the primary function of the Regional Sediment Management GIS. A budget quantifies sediment erosion and accretion throughout the region caused by material processes. Sediment budgets lay the foundation for understanding a complex inlet and coastal system, under natural or engineered conditions.

- The SBAS-A is a tool that allows many local (project-level) sediment budgets to be characterized within one or more regional sediment budgets. Features of SBAS-A have been designed to facilitate creation and display of both the local and regional sediment budgets.

- SBAS-A is a software component designed for ArcGIS that is used to create and analyze sediment budgets for coastal inlets.

- SBAS-A facilitates calculating and displaying local and regional sediment budgets including single and multiple inlets, estuaries, bays, adjacent beaches, and through the watershed.





Sediment Budget Equation

$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = Residual$$

Q source , Q sink = Import or Export to the cell

ΔV = Volume change within cell

P = Placement in the cell

R = Removal in the cell

Residual = cell surplus or deficit, 0 = balanced cell

Qsource and *Qsink* are the sources and sinks to the control volume, respectively, Δ*V* is the net change in volume within the cell, *P* and *R* are the amounts of material placed in and removed from the cell, respectively, and *Residual* represents the degree to which the cell is balanced. For a balanced cell, the residual is zero. For a region consisting of many contiguous cells, the budgets for individual cells must balance in achieving a balanced budget for the entire regional system.

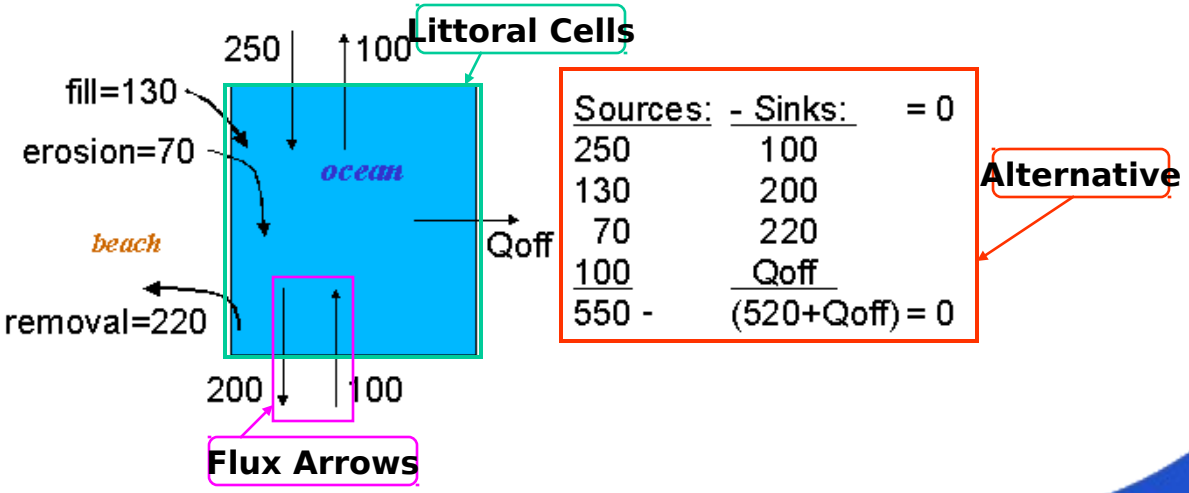
A **sediment budget** is a tallying of sediment gains and losses, or sources and sinks, within a specified control volume (or cell), or series of connecting cells, over a given time.

Sediment Budget Analysis System

- **Alternative**: An alternative represents one set of assumed conditions for a particular sediment budget. Each Alternative has its own set of fluxes, cells, placements, and removals. Alternatives may be created to reflect different assumptions about sediment-transport magnitudes and pathways, and engineering activities within the budget, or a different time period as compared with the original formulation. At least one alternative must be created in the SBAS-A session. The alternative will save all values applied to cells and fluxes.

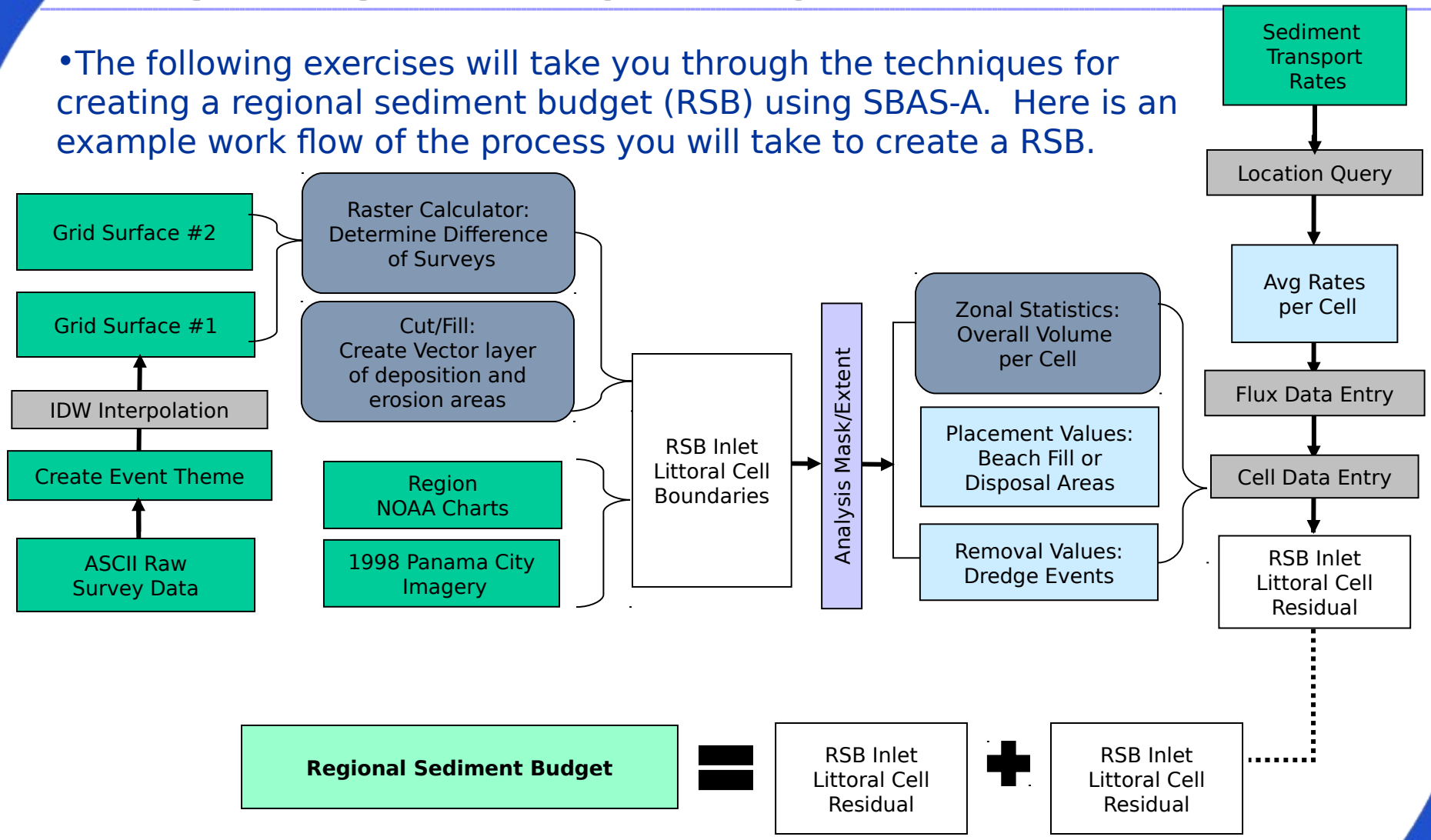
- **Littoral Cells**: A collection of information describing similar physical, biological, and cultural characteristics within a particular area.

- **Flux**: Flux values represent input and output of sediment into the cell. Each sediment budget cell requires eastward and westward transport rates.



SBAS-A Workflow

- The following exercises will take you through the techniques for creating a regional sediment budget (RSB) using SBAS-A. Here is an example work flow of the process you will take to create a RSB.



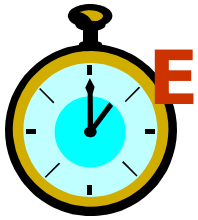
Instructor Demonstration

Creating a Regional Sediment Budget with SBAS-A

Exercises A-B: Building Graphics to Represent Budgets

What to Expect:

Using the ***Drawing Tools*** in ArcMap, you will be able to generate graphic polygons and polylines to represent littoral cell areas and sediment transport direction.



Estimated Length: 25 Minutes

Determining Budget Values

Now that the conceptual model has been designed for the area of interest, values can be attached to the Alternative to create a Regional Sediment Budget. Values can be obtained from a variety of sources, including data models (GENESIS), survey data (CHARTS), or dredging databases (Silent Inspector). Below are a list of data types that can be used to assist in the development of a budget.

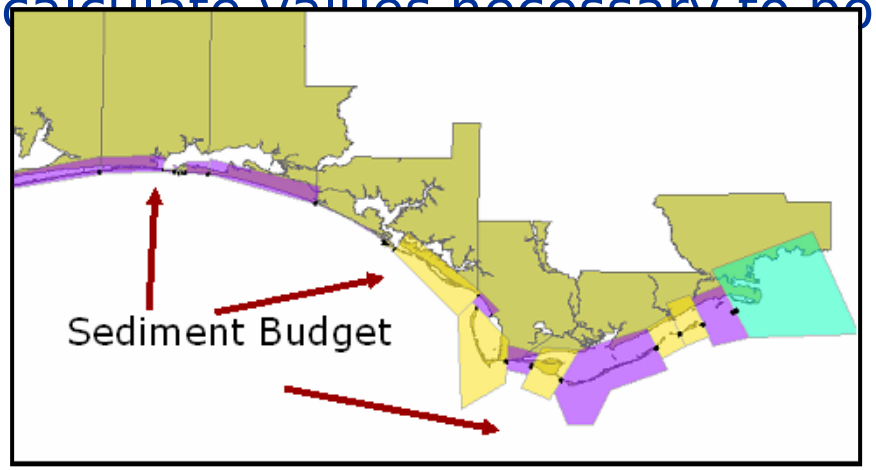
Gains	Losses	Net
•Longshore transport into area •River transport •Sea cliff erosion •Onshore transport •Biogenic deposition •Wind transport onto the beach •Beach nourishment	•Longshore transport out of area •Offshore (or cross-shore) transport •Wind transport inland •Deposition in maintained navigation channels •Transport through submarine canyons •Solution and abrasion •Mining •Other anthropogenic causes	•Beach accretion or erosion (sand gains and losses)

Residual Calculations

- Residual represents the degree to which the cell is balanced. Residual is only zero is the cell is balanced. The sediment

$$\sum Q_{source} - \sum Q_{sink} - \Delta V + P - R = \text{Residual}$$

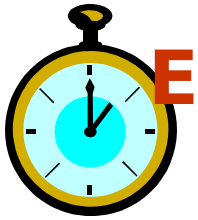
- This process of creating cell and flux areas and calculating the residual allows a regional budget to develop. Once a budget is established, it can be used as the baseline for scenarios. A GIS provides a data repository and the tools available to create and calculate values necessary to populate a sediment budget.



Exercises C-F:
Adding Budget values

What to Expect:

To determine the volume of littoral cells and fluxes, values can be computed from bathymetric datasets or acquired from model outputs. Using SBAS-A, these values can be added to the graphical budget.

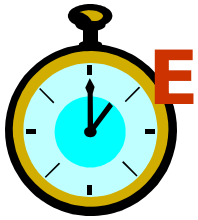


Estimated Length:
25 Minutes

Exercises G:
Creating Macro Budgets

What to Expect:

Once micro-budgets are created for individual systems, they can be merged and calculated into a Macro Budget. Macro Budgets help view a sediment transport on a regional basis.

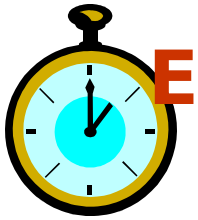


Estimated Length:
5 Minutes

Exercises H:
Saving Alternatives

What to Expect:

Alternatives are used to store the sediment budget values. They are also used as an exchange to data between the stand-alone SBAS and SBAS-A. This lesson will provide instructions for saving alternative files.



Estimated Length:
5 Minutes